

## THE SURGERY OF THE THORACIC DUCT.

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THE thoracic duct has, from time to time, been the seat of injury, especially during operations on the neck, and in some instances, attempts have been made for its repair. Such cases are of great surgical rarity, and for this reason contributions to the surgery of the duct, are of professional interest. Rupture of the thoracic duct, as an accompaniment of the gunshot wound of the lung, has thus far been observed but once. It is no wonder that such injuries are rare, since the aorta lies in such close relationship to the duct that death usually occurs at once.

A recent case may be found in the book of Graff and Hildebrandt upon "Wounds Caused by Modern Firearms,"<sup>1</sup> and is there described as follows:

The projectile passed from a point in the region of the apex of the heart, obliquely backward and to the right of the spinal column. Probably the wall of the duct was contused and necrosed, since the first symptoms of leakage developed only after a few days. The diagnosis was then made because of the chylothorax which developed. Several aspirations of the pleural cavity were necessary, and the patient finally recovered. Collateral branches evidently became functionally active, while the main duct which was injured, closed. The chyle ultimately reached the blood current through the newly dilated channel.<sup>2</sup>

A case in which the thoracic duct was injured during an operation upon the neck, was reported by the writer in his

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<sup>1</sup> "Die Verwundungen durch die modernen Kriegsfeuerwaffen," by Drs. Graff and Hildebrandt, Berlin, 1907.

<sup>2</sup> Dietze, "Ueber Chylothorax traumaticus," Deutsche Zeitschrift für Chirurgie, vol. 73, p. 450.

recent article upon "A New Disease of the Thoracic Duct."<sup>3</sup> This was contributed by Dr. L. W. Pearson of Brooklyn, and may be summarized as follows:

Mrs. E. K., 45 years of age, suffered from enlarged cervical glands which had existed for about a year. They were most pronounced upon the right side of the neck and the mass extended nearly to the level of the clavicle. An operation was performed April 8, 1905, and the enlarged glands were removed. One gland which had suppurated and the fistulous tract leading to it, were also dissected away, the dissection extending to about an inch above the clavicle. Hemostasis was effected, and the wound was closed. The patient recovered from the anæsthetic and did well. On the fourth day she had one degree of temperature. On this day the dressings were removed. There was no suppuration, but the tissues near the suture line had melted away.

Two days later there was edema of the parts along the line of the incision and adjacent thereto. A probe was inserted at the lower point of the incision and a thick, curdy material began to pour out. As the wound was held wider open, about a pint of this material was evacuated. The wound was irrigated and cleaned, and then it was found that from the lower part of the wound, chyle welled up. This was removed as fast as it was sponged away, and for the next five days, large quantities of chyle escaped more or less continuously. The dressings were saturated and needed frequent changing. Notwithstanding this loss of the products of digestion, there was no especial sense of hunger expressed by the patient, through she was growing somewhat weaker. The temperature varied from 100° to 100.5° and the tissues melted away. At no time was pus present.

On the eleventh day when the dressings were removed for inspection, the flow of chyle seemed to have diminished. The wound was tightly packed with iodoform gauze with hope of its closing. On the next day, the flow of chyle was very slight, on the following day no chyle appeared. The wound itself rapidly closed in from this time forward, and convalescence was uneventful.

By far the most valuable contribution to this subject, however, is the one recently found in the "Festschrift" in honor of the seventieth birthday of Prof. Ernst von Bergmann, and was prepared by Dr. Fritz Lotsch.<sup>4</sup> It is as follows:

"A wound of the ductus thoracicus at a point near its outlet is an always rare complication of operations upon the left side of the neck."

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<sup>3</sup> New York State Journal of Medicine, July, 1907.

<sup>4</sup> Ein Beitrag zur Chirurgie des Ductus thoracicus, by Fritz Lotsch, Surgeon 30th Regiment, Madgeburg Fusiliers, Berlin, 1906.

The first observation recorded upon this subject, was made by von Boegehold in the year 1883. He writes:

"Strangely enough, with the exception of the case observed by me I have never seen a reference to wounds of the thoracic duct in the neck, although with the extirpation of large tumors in this region, such an accident can easily happen."

Since that time current literature upon this subject has slowly increased from year to year. Unterberger<sup>6</sup> collected at the end of the year 1905, all of the cases in the Königsberg Surgical Clinic, of operative wounds of the thoracic duct which had occurred and found them to be thirty in number.

Certainly not all cases have been recorded; for instance, in the atlas of Bockenheimer and Frohse it is stated "In spite of all care it will some time occur in the sawing through of the clavicle that the thoracic duct is wounded. It is not necessary to suture it, since a tamponade will, as a rule, remedy the injury."

It is certain, however, that the wound of the duct, considering the vast amount of material reported, is not an everyday occurrence. The case reported by Dr. Lotsch is as follows:

Mrs. Clara H., aged 30 years; recurrent sarcoma of thyroid gland. Partial resection of gland at primary operation April, 1904. Secondary operation April, 1905.

Transverse incision of the old scar. Extirpation of the individual tumor masses. The left internal jugular vein was ligated.

During the dissection of the nodules in the left supra-clavicular fossa, the deeper portion of the wound suddenly filled with turbid milky fluid, which welled up instantly as soon as it was sponged away. The duct, the size of a straw, was exposed and a cut involving one-third of its circumference was visible. The incision was closed with three fine catgut sutures. The chylorrhea ceased. During further dissection the bulb of the left common jugular vein was exposed and was accidentally torn open. The severe hemorrhage which occurred through this slit-like wound was controlled by a suture of the wall of the vessel. The tumor was finally removed upon both sides, each mass the size of a pigeon's egg. Both surgical triangles of the neck, from the angle of the jaw to the aperture

<sup>6</sup>Unterberger, Ueber operativ Verletzungen des Ductus thoracicus, Beiträge zur klinische Chirurgie, Bd. xlvii, Hft. 3.

of the thorax, were dissected as free as in an anatomical preparation. Gauze drainage. Suture of the wound.

April 13. Temperature continues normal. A marked edema of the left side of the face had developed. Otherwise the patient was in excellent condition. The wound healed per primam. In the drainage opening fresh granulation tissues appeared. The wound being nearly healed, she was permitted to go home.

March, 1907, one year after the second operation, the patient was found to be entirely free from recurrent growth and in excellent health. (This ends the case history.)

This case had to do, therefore, with an oblique wound of the thoracic duct in the supra-clavicular fossa occurring during the extirpation of a firmly adherent secondary nodule of sarcoma.

The severe chylorrhea was controlled by catgut sutures of the wounded duct.

At the present time the therapy of wounds of the thoracic duct has not a firm basis chiefly because of anatomical variations and partly also for physiological reasons. At least from a practical surgical point of view the rules thus far laid down are uncertain.

Even to-day, the conclusions reached by Tholes (1901) are still accepted. "Our knowledge of the exact anatomical relations is still defective and needs the added experience of numerous investigations, such as are given in the works of Boegehold and Wendel. Perhaps it will develop that many conditions now regarded as variations, will prove the normal condition and are the natural safeguards of the body against an occasional wound of such an important structure."

The real question to be considered, therefore, is, Is it possible to ligate with safety the wounded trunk of the thoracic duct in man?

The thoracic duct conveys, as is well known, the finished products of digestion, the chyle, into the blood current and in addition collects the lymph of the entire body, with the exception of the right upper half of the body, whose lymph channels ultimately fuse in the ductus lymphaticus dexter. The current of the chyle is controlled by the movements of respiration. With each inspiration there occurs a temporary negative pressure within the thorax, which sucks the chyle from the

abdominal cavity. Some observers have occasionally discovered that the chyle has a rhythmic motion synchronous with each inspiration very similar to the pulse. (Keen, Cushing, Schroeder-Plummer, Lecène.)

Concerning the course and topography of the extra-thoracic portion of the thoracic duct, the following is a short résumé.

The ductus thoracicus passes on the left side of the œsophagus in the cephalic aperture of the thorax. At the level of the sixth vertebra it turns sometimes in an acute, sometimes in an oblique curve, upward and forward, and terminates in the angle of junction of the left sub-clavian vein with the jugular vein where both of these vessels unite to form the vena anonyma sinistra. Shortly before its termination it receives the lymph duct, coming from the left side of the head and neck (*truncus jugularis sinistra*), as well as that of the left arm (*truncus sub-clavius sinistra*), finally also the *truncus lymphaticus mammarius sinistra*.

At the mouth of the duct in the wall of the vein there are two valves which prevent the flow of blood back into the lymph channel.

It is well recognized how variable and inconstant the course of even the large lymph vessel is, and attention has often been called to the frequent inconstancy in position of veins, arteries and lymph vessels. These variations occur also in the ultimate termination of the great lymph channels, the thoracic duct.

In the present instance we are concerned chiefly with the anomalies in the region of the mouth of the duct. It is important for surgeons to know that the thoracic duct occasionally terminates upon the right side, and that upon the left side in such cases the duct conveys only the lymph from the left upper quadrant of the body into the blood current. Whether these anomalies habitually occur with *situs viscerum inversus* has not yet been determined. Very often anomalies of the blood vessels are present in the same individual.

Of primary importance for the surgeon in treatment of

the wounds of the duct, is the position which the terminal opening occupies in the vein, whether it is in the re-entrant angle or in the jugular or in the sub-clavian vein alone. All possible combinations may occur which can be theoretically imagined. The jugular, sub-clavian and the mammarius veins sometimes have the duct lying close along the wall of the vein; sometimes the ducts of which there may be several are separate and enter the blood current in two or three places. Several anastomoses can sometimes be determined. Not infrequently the duct, after it is joined by the already mentioned lymph channels, divides into a larger or smaller number of fine vessels, sometimes short and sometimes long, which separate or anastomose in several places before they finally enter the wall of the vein. This delta formation is probably the reason why so many variations have been observed. As a rule it is probable when the main channel fills that most of the chyle will pass through it and the smaller ones become so attenuated from inactivity that they escape observation.

In a similar manner may be explained those anomalous lymph channels which have been observed and described in connection with the lymphatic glands of the breast, as they course along the wall of the thorax or of the abdomen. Wutzer, Wendel and Arnold have described communications with the vena azygos; Wendel has observed one with the vena renalis.

When one considers what an important rôle the thoracic duct plays in the function of the entire body, it is little wonder that numerous collateral branches exist to provide against emergencies.

A great many investigators have sought through experiments upon animals to answer the question as to the result in case the thoracic duct was completely occluded. Most of these investigations have been conducted upon dogs. The result in the greater number of cases was merely a temporary impairment of nutrition.

On the other hand, if the duct is cut through without ligating it, there occurs at once the symptoms of a profuse

chyloorrhea, which if it be not checked either by accident or by design, will in a short time lead to progressive loss of strength and finally to death.

In the wounds of the duct which have occurred during operations this chyloorrhea, strangely enough, often does not develop for some hours and often even days after the lesion has taken place. (Thöle, Schopf, Phelps, Vagedes, Ricard, Wendel, and Halsted.) Probably in these cases there was a narrow slit in the wall of the duct which was temporarily closed, by a small clot of blood or something of that sort.

The tremendous amount of chyle which can escape through the duct which has been opened by accident has been shown in some operative cases, in which efforts to check the chyloorrhea did not succeed. (Schwinn, Schroeder-Plummer, Schopf, Ricard and Thöle, whose patient was literally deluged in chyle.)

Especially characteristic in this connection is the case reported by Hahns, in which as a result of an intra-thoracic rupture of the duct nearly 30 litres of chyle were withdrawn by aspiration.

The disease picture which develops as a result of chyloorrhea has been observed and described several times (Wendel, Schwinn, Schroeder-Plummer, Schopf, Ricard, Thöle). The digestive organs work in vain. Hunger and appalling thirst develop. Ingestion of food is followed by a marked increase in the chyle which forms and escapes. Emaciation and progressive loss of strength, weakness of the heart action and finally loss of consciousness follow as a result of such a condition. Whether the fever which has been occasionally observed is due to absorption of nucleins and albumins is not certain.

Death, notwithstanding all this, is rather uncommon. The chyle possesses a certain ability to coagulate, yet as a rule, sooner or later the stream of chyle reaches the general circulation through other newly dilated channels.

In many cases after tamponade of the wounded duct, the patient complains of a pressure in the thorax. When the bandage is loosened in such cases, profuse chyloorrhea is observed.

More frequently in the first few days after the accident, circumscribed edema occurs in the certain areas. Unterberger describes edema of the left arm; in our own case an edema of the left side of the face was observed which was increased after the ligation of the jugular vein. All these observations seem to indicate that a certain time is needed to establish collateral circulation and to give these non-functionating vessels a chance to dilate. It has never happened, however, that the pressure in the duct in any case is so greatly increased that a rupture of the duct or of one of its radicles has occurred.

The disturbances of circulation which have occurred after operative wounds of the duct have taken place, are as a rule not excessive,—since the pressure of the tumor masses or of the large abscess cavities has already caused a certain development of the collateral branches before the operation takes place.

In the 31 cases observed, 15 were operated on because of malignant tumors (usually metastatic), and 13 because of tubercular adenites. In two (Cheever and Schroeder-Plummer) the character of the tumor is not stated, and in one case (Ferguson) an aneurism of the left sub-clavian artery existed.

In all of these cases there existed conditions which might give rise to marked pressure upon the duct, and therefore it is not possible to exclude the possibility of a more or less collateral circulation. Some observers have described the escape of the chyle in a rather thick stream (Boegehold and Lotsch) of the size of a straw; Schwinn speaks of the size of a knitting needle. Lecène gives a lumen of from 1 to 3 mm.

Two cases of death have occurred in the 31 cases reported in which the thoracic duct has been wounded during the operation (Cheever, Schopf). Lotsch does not agree with most of the writers that one is therefore justified in regarding this as the cause of death. The patient of Cheever died thirty-six hours after a very severe operation as the result of shock. The chyloorrhea was checked by a firm tamponade.

The patient of Schopf dies 16 days after the operation. Autopsy showed an excessive chylothorax on both sides, with a



fibrous pleurisy and pericarditis on the left side, so that death cannot properly be ascribed to the wound of the duct alone.

It therefore follows that the prognosis in wounds of the duct is by no means so bad as it appears to be at first sight. Efforts made to check the chylorrhœa in some way or another have nearly always succeeded. In the more unfavorable cases a pronounced loss of strength developed, from which the patient recovered after a long convalescence.

In view of our present knowledge of this subject, are we justified in treating the wound of the duct precisely as we treat those of blood vessels. Several methods are to be considered in this connection.

1. Ligature. 2. Suture. 3. Suture of the enclosing tissues. 4. Application of an artery clamp. 5. Compression by firm tamponade.

The implantation in the vein of a duct which has been cut across (Schopf) is scarcely possible on technical grounds, and has completely failed in satisfactory results.

Of the various methods which have been attempted, the one should be given the preference which with certainty will check the chylorrhœa at once. All plans are not of equal value. Ligation or suture upon the one side and tamponade upon the other may be compared with each other. Formerly most operators preferred tamponade, but in more recent years nearly all authorities have recommended ligation. In most cases tamponade has failed to check the chylorrhœa immediately. Ligation and suture when properly applied at the place of the injury must of necessity check the flow of chyle. They are therefore the methods to be preferred.

One drawback, however, exists—a technical one. It is often impossible, at the bottom of a funnel-shaped wound, to see the exact site of the injury and to grasp the duct. The nearness of the pleural cavity and of the large blood vessels of the neck, adds a considerable risk, and it is with great difficulty that the duct can be grasped for the proper application of a suitable clamp. In such cases of necessity the tamponade may be used when other methods cannot be applied without great

additional danger. Actual suture at the site of the injury on the wall of the duct, occupies a peculiar place. In many cases occurring during the operation, the surgeon has to deal not with the total division of the duct, but rather with a slit-like opening caused by the firmly attached portions of tumor breaking the wall of the duct during their removal. If it be possible to bring this slit clearly in view, then a suture is technically possible, and the result must be a most satisfactory one.

The wound does not close spontaneously, since the chyle has little tendency to form a clot, and the pressure from within is great enough to keep the wound open. It therefore follows that a suture can be used only in a limited number of cases, and in any case, is not technically easy. It is however to be attempted in this special class of cases, since it is the only means of controlling the leakage from the duct.

In the 30 reported cases, ligature was used 9 times, 6 times with an immediate result. In 2 cases the result was attained only after a certain time (Weischer 8 days, Unterberger 18 days, Schroeder-Plummer (2), Lesniowski (2), Brohl, Thöle, Receni and v. Graff). The case of Ferguson is not included, since the attempts at suture failed. Schroeder-Plummer had to report a complete lack of success in his first case. The ligature was applied when the clamp was removed and immediately the chylorrhea recommenced, a certain indication that the ligature was not properly applied. Tamponade for three months led to a progressive cessation of the chylorrhea. This mischance was not due to the fault in the method, but rather to the imperfect technique.

Suture of the tissue (Umstechung) was used in two cases of Wendel and von Schopf, and both cases were successes. In Wendel's case neither tamponade nor clamps nor repeated tissue suture succeeded in checking the chylorrhea. Suture gave only temporary benefit. Finally the use of a firm tamponade held in place for five weeks. Clamps applied for a considerable time were used in this case.

Phelps and Schwimm could not ligate the duct because of the depth of the wound. A clamp was applied and left in

place for three days; this succeeded in terminating the chylorrhea. In Wendel's case two clamps were applied. Chylorrhea ceased on the fourth day. In three cases the method failed and tamponade was then applied.

In 13 cases a tamponade was used; in 6 the flow was controlled at once. In Ricard's case the wound was dressed upon the sixth day and then for the first time a collection of milky fluid was observed. This is very similar to the case of Pearson. This was first thought to be pus, and only after 14 days was a tamponade applied. In the remaining cases chylorrhea ceased after a variable time (from five days to five weeks). Both cases which died (Cheever and Schopf v. s.) were treated by means of tamponade.

#### CONCLUSIONS.

1. The thoracic duct probably has collateral branches always which are able, in case of accident, to perform the function of the main duct. Further anatomical investigations concerning this are greatly to be desired.

2. The sudden closure of the duct in man has had as its result only transitory disturbance in the nutrition of the body.

3. Chylorrhea occurring after a wound of the duct, must, if possible, be immediately controlled.

4. The wounded thoracic duct may be treated precisely as we would treat a wounded blood vessel.

5. Suture is the ideal method. If it is technically possible, its use is to be preferred, since the duct then remains patent.

6. In all cases in which suture can be performed, a ligature should be applied. If ligature is technically impossible then in order of value, suture of the tissue (*Umstechung*), application of clamps, and in emergency, as a last resort, tamponading should be applied.

NOTE: *Bibliography*.—A complete bibliography of the subject will be found appended to the memoirs of *v. Graff*, *Zur Therapie der operativen Verletzungen des Ductus thoracicus*, *Weiner klin., Wochenschr.* 1905, Nr. 1, and *Unterberger*, *Ueber operative Verletzungen des Ductus thoracicus*, *Beiträge zur klin. Chirurgie*. Bd. 47, Heft 3.